

TAKING OFF WITH ESTIMATION THROUGH THE FIELD OF AVIATION

INTRODUCTION

Students will investigate how estimation and formula manipulation are used in the field of aviation. The lessons and assessments provide realistic Algebra applications for airplane mechanics, private pilots and airplane engineers. This lesson requires students to estimate fuel consumption and mileage for different length flights. In the field of aviation pilots are required to determine this information before takeoff in order to know if the airplane has adequate fuel and for the passengers to know the flight time.

LEARNING OUTCOMES

Students will estimate reasonable answers and manipulate formulas related to fuel consumption in airplanes. The students will analyze different scenarios and determine if their estimations are accurate and derive formulas from the scenarios.

CURRICULUM ALIGNMENT:

COMMON CORE STANDARDS: MATHEMATICS

N.Q.1: Use units as a way to understand problems and guide the solution of multi-step problems; choose and interpret units consistently in formulas.

N.Q.2: Define appropriate quantities for the purpose of descriptive modeling.

N.Q.3: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

CLASSROOM TIME REQUIRED

The time required to complete this lesson is two block periods (180 minutes). It is recommended that day one should include pre-activity, presentation and assessment. Day two should include the day two assessment.

TEACHER PREPARATION

For the exploration activity, the teacher will need to cut out the questions and answers on the [Activity Opener](#). Place the ten questions and the answers into envelopes; the number of envelopes will depend on the class size.

For the assessment activity, prepare the [Formulas Fill-In](#). Consider laminating the sheets and allow the students to fill-in-the blanks with overhead markers or create the charts on post-it paper and display them in the room.

For the day one assessment make popsicle sticks labeled A through D if CPS clickers are unavailable. Label the sticks using permanent marker with the letters A through D.

MATERIALS NEEDED

- All lesson handouts
- Envelopes
- Tape
- Construction paper
- Aviation video
- Vis-à-vis markers
- Lamination or post-it paper
- Popsicle sticks labeled A through D or student whiteboards with markers

TECHNOLOGY RESOURCES

- Computer projector and screen
- Estimating in Aviation & Algebra Presentation at <http://prezi.com/ufpwyghujbqt/estimating-in-aviation-algebra/>
- Air Crash Investigation Video:
http://www.youtube.com/watch?v=yYqSdbFzFUo&feature=player_embedded
- Calculators
- PowerPoint
- CPS clickers (optional)

PRE-ACTIVITIES

Prior to this lesson students should know how to set up and solve proportions and be familiar with estimation.

ACTIVITIES

1. Show students video clip about aviation investigations:
http://www.youtube.com/watch?v=yYqSdbFzFUo&feature=player_embedded or
<http://natgeotv.com/uk/air-crash-investigation/videos/>
2. A discussion with the class after the viewing clip is encouraged.
Some possible discussion questions:
 - Do you think that planes often run out of fuel?
 - Do you think that most plane accidents happen because of mechanical failure?
 - How much fuel do you think a plane holds?
 - What types of things do you think pilots need to consider before they takeoff?
3. After the video clip discussion, divide the class into pairs.
4. Each pair will need a piece of construction paper, tape and an envelope that contains the ten questions and answers.
5. Tell the students that they are going to take the questions and answers out of the envelope. Then, the students will work together to figure out their best guess on the number that goes with each question. When the student pairs agree with their guesses they will tape the questions and answers together on the construction paper.

6. Display the guesses throughout the room. The answers will be given throughout the lesson and can be used as a guide for estimation. (For example: If someone made an estimation that was way off, explain to students why that couldn't be possible) Teacher can give the answers throughout the Prezi or throughout the lesson.
7. If a pair makes a correct estimation record a point on their construction paper. As the lesson continues on, let students make adjustments to their estimations.

GUIDED PRACTICE

1. Show students the Prezi: Estimating in Aviation & Algebra presentation at <http://prezi.com/ufpwyghujbqt/estimating-in-aviation-algebra/>
To advance the presentation use the arrows in the gray bar along the bottom of the presentation window.
2. Students should use estimation to answer questions throughout the Prezi
3. After going through the questions using estimation, introduce the formula.
4. Distribute the Formulas noteguide to their students.
5. The students are prompted throughout the Prezi to write the formulas down.
6. A T-chart is used for formulas in the noteguide. Explain to the students, if they are not familiar with T-charts that you divide if the two numbers are vertical (going down) and multiply if the two numbers are horizontal (going across) on the chart.
7. Go through the entire Prezi with the students and allow students time to estimate on their own. One option is for students to hold up 1 finger for Option A or 2 fingers for Option B; or some other form of immediate assessment of their estimation skills.

ASSESSMENT

DAY ONE ASSESSMENT

1. Teacher should insert the PowerPoint: [ManipulatingForm Quiz](#) into the CPS clickers program.
2. If the CPS clickers are not available, teacher should display the [ManipulatingForm Quiz](#) so students can see it.
3. If CPS clickers are the preferred method of giving the quiz, if they are available.
4. If the CPS clickers are not available two other options are:
 - a. Make sticks with the letters A through D labeled on them and give each student (or pair) a set of sticks to hold up when they have their answer.
 - b. Have students write down their answers on whiteboards and students can hold up the whiteboards when the teacher directs them to.

DAY TWO ASSESSMENT

1. Place the students in groups of two or three. *Option:* Teacher may want to use within-class ability grouping because the sheets are made with increasing difficulty.
2. Some of the [Formula Fill-in](#) are more difficult than others and are in order of difficulty. Strong groups should be given sheets 5 or 6. Sheets 3 and 4 are medium difficulty and the easiest sheets are 1 or 2.
3. Distribute the [Formula Fill-In](#) laminated sheets and the estimations to each group.

4. The students should first use the estimations provided to make accurate estimates. No calculators are allowed.
5. After ten to fifteen minutes give the students a calculator.
6. The students should fill in the blanks with the accurate numbers using the formula ($G = rt$)
7. Direct the students to check their answers with their estimations.
8. After the students finish the [Formula Fill-In](#), have them switch with a different group. (1 or 2's should switch with 1 or 2's...etc.)
9. When the students switch they will check to make sure the other group's answers are accurate.
10. Have the students hand back the [Formula Fill-In](#) to the original group.

MODIFICATIONS

Sometimes pilots use a flight computer to figure out the fuel consumption and flight time, it could be beneficial to show students what a flight computer is and if time permits how to use it

Flight computer can be purchased at www.sportys.com or a more affordable paper flight computer can be purchased from www.mypilotstore.com

ALTERNATIVE ASSESSMENTS

Instead of giving the quiz as an informal assessment, give the ten question Manipulating Formulas Quiz.

CRITICAL VOCABULARY

Fuel Consumption: the average fuel used by a vehicle during a trip

Flight Computer: a type of circular slide rule used in aviation

WEBSITES

- Prezi www.prezi.com
Prezi is an alternative to the usual PowerPoint presentation slide show.
- Hybrid cars and alternative fuels www.alternativefuels.about.com
- National Geographic's Air Crash Investigations <http://natgeotv.com/uk/air-crash-investigation/videos>:
This site offers videos on plane crashes throughout history that can be used to engage students with aviation.
- MyPilot Store www.mypilotstore.com
This website sells many pilot necessities, including a paper flight computer that can be used in this lesson.
- Sporty's Pilot Shop <http://www.sportys.com>
This website has a more advanced flight compute than the paper flight computer for purchase.

AUTHOR INFORMATION

Danielle Flores is a 2012 Kenan Fellow and has been an educator for eight years: five years at Ragsdale High School in Jamestown, NC and three years at East Hartford High School in Connecticut. Her fellowship included working with Audrey Floyd at the GTCC Aviation Center in Greensboro, NC. She has worked with Guilford County on creating lesson plans, pacing guides and presenting at the Summer Math Institute for new curriculum. Danielle has also worked with state on creating the end of course exam for Algebra I and she continues to work on creating assessments for the ACT tests.

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